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## **EUROPEAN PATENT APPLICATION**

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**(54) Connector and cable comprising the same**

(57) The invention pertains to a connector comprising a housing, a plurality of electrical contacts, and at least one resilient latch for establishing a mechanical connection with a counterpart comprising an opening, such as a slot or notch, for receiving the latch. The latch comprises an extension which, upon connection of the connector to the counterpart, engages with a rim or inner

wall of the said opening and in that the surface of the extension that contacts the said rim or inner wall is curved. In an alternative embodiment, the latch comprises a second extension which reaches beyond a second rim or inner wall of the opening opposite the first rim or inner wall and which abuts the counterpart upon rotation of the connector about an axis substantially perpendicular to the insert direction of the connector.

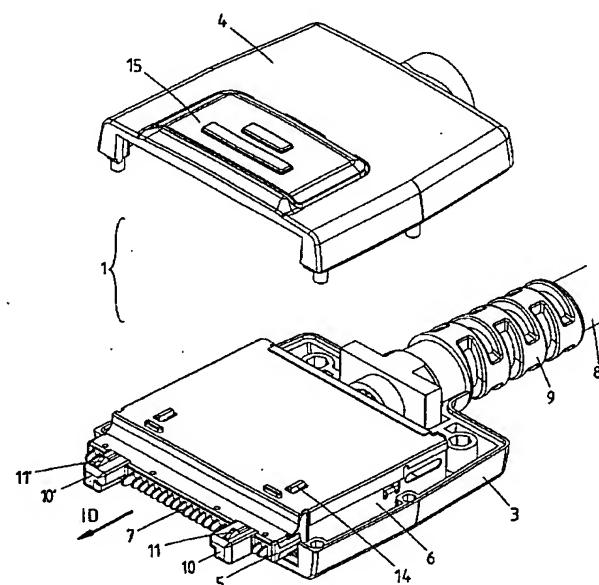


fig.1

**Description**

[0001] The invention pertains to a connector comprising a housing, a plurality of electrical contacts, and at least one resilient latch for establishing a mechanical connection with a connector counterpart comprising an opening, such as a slot or notch, for receiving the latch.

[0002] A connector of this type is disclosed in European patent application 0 898 333 A2, which describes (in conjunction with inter alia figure 1) a cable connector (numeral 20) including a terminal block or housing (22) formed of an insulating material. Terminals (24) are placed in slots in the housing (22) and extend beyond the front face of the said housing (22). The housing (22) further includes a pair of laterally spaced guidance pegs (26) that may include polarising features for insuring correct mating with a receptacle connector (e.g. as shown in figure 13). Because the terminals (24) are spring-loaded in order to develop sufficient contact forces by compression against stationary contacts (84) in the receptacle connector (80), there is inherently a force that tends to separate the two connectors. To counteract this force, it is necessary to latch the plug and receptacle connectors together during use. To this end, each of the pegs (26) is provided with a resilient latch arm (30) which includes a distal portion carrying a latch pawl (32). The receptacle connector (80) comprises two openings (88) the front edges (89) of which, upon connection, are engaged by the latch pawls (32). The said connector (20) is released by pressing the latch pawls (32) downwards.

[0003] It is an object of the present invention to provide an improved connector of the type described in the opening paragraph and a cable comprising the same.

[0004] To this end, the connector according to the present invention is characterised in that the latch comprises an extension which, upon connection of the connector to the counterpart, engages with a rim or inner wall of the said opening and in that the surface of the extension that contacts the said rim or inner wall is curved.

[0005] As will be explained below, the use of a curved surface instead of a straight surface allows more effective control over the so-called retention force, i.e. the force with which the connector is retained in its counterpart in a direction substantially parallel and opposite to the insertion direction of the connector. As a result, inadvertent release of the connector is less likely to occur.

[0006] In a further embodiment of the present invention, the latch comprises a second extension which reaches beyond a second rim or inner wall of the opening opposite the first rim or inner wall and which abuts the counterpart upon rotation of the connector about an axis substantially perpendicular to the insert direction of the connector.

[0007] As a result, the latch will be withdrawn from the said opening, thus releasing the connector and reducing the risk of damage to the connector or its counterpart when, e.g., someone trips over a cable which has been

attached to a mobile telephone.

[0008] The invention will now be further explained with reference to the drawings in which several features and embodiments of the connector according to the present invention are schematically shown.

[0009] Figure 1 shows in perspective a connector in which the features of the present invention can be applied.

[0010] Figure 2 shows part of a cross-section through a connector according to the present invention, which is otherwise similar to the connector shown in figure 1.

[0011] Figures 3A and 3B show in perspective a bottom and a top view of a connector counterpart for use in a mobile device.

[0012] Figure 4 shows a detail of the connector according to figure 2.

[0013] Figures 5A and 5B a first alternative to the connector according to figure 2.

[0014] Figure 6 shows a second alternative to the connector according to figure 2.

[0015] Parts and features which are substantially the same or which perform substantially the same function are denoted by the same numeral.

[0016] Figures 1 and 2 show a connector or plug 1, such as an input/output plug for a mobile telephone, suitable for connection to a connector counterpart or receptacle 2 (shown in figure 3). The plug 1 comprises an outer housing consisting of a lower or main part 3 and an upper part or cover 4. The outer housing contains an inner housing 5 made of an electrically insulating thermoplastic material and is placed inside a shielding 6 of a folded metal sheet. The inner housing 5 is fitted with a plurality of spring-loaded terminals 7 arranged in a row and extending through the front of the inner housing 5.

[0017] The terminals 7 are electrically connected to respective wires (not shown) in a cable 8, whereas the shielding 6 of the housing 5 is electrically connected to a braid (not shown) in the cable 8, which braid surrounds and thus shields the said wires. A strain relieve 9 is provided in the rear of the outer housing so as to avoid excessive forces on the (solder)connection between the terminals 7 and the wires when the cable 8 is being bent.

[0018] The inner housing 5 is provided with two substantially parallel pegs 10, 10', for aligning and polarising the plug 1 with respect to the receptacle 2, each of which pegs 10, 10' contains a resilient latch 11 respectively 11'. As can be seen in figure 2, the latch 11 is part of a substantially flat element 12, which further comprises a barbed retention portion 13 for securely positioning the element 12 in a corresponding cavity in the inner housing 5, and a release stub 14. The release stub 14 co-operates with a push button 15 on the cover 4. When this push-button 15 is pushed down, the latches 11, 11' flex downwards. The elements 12 can, for instance, be stamped from a single metal sheet. For further details on the connector 1 and counterpart connector 2, reference may be had to EP 0 898 333. The terminals 7 are described in more detail in EP 718 918.

[0018] Figures 3A and 3B show, in top and bottom view, a receptacle 2 which has been soldered on a printed circuit board (PCB) 16 of a mobile device, such as a mobile telephone. The receptacle 2 comprises a housing 17 of an electrically insulating thermoplastic material placed inside a shielding 18. The housing 17 comprises a row of first cavities 19, each of which contains a contact element 20, and two larger second cavities 21, 21' for receiving the pegs 10, 10'. The number and pitch of the cavities 19, 21, 21' and contact elements 20 correspond to those of pegs 10, 10' and the terminals 7 in the connector 1, thus allowing effective electrical contact between the terminals 7 and the contact elements 20 upon connection of the plug 1 to the receptacle 2. The contact elements 20 further extend through the rear of the housing 17 and are soldered to leads (not shown) on the PCB 16.

[0019] The shielding 18 comprises two rectangular openings 22, 22' for receiving the latches 11, 11' so as to establish a secure mechanical connection between the connector 1 and its counterpart 2. The latch 11, which is shown in more detail in figure 4, comprises a first extension or pawl 23 having a curved, preferably concave surface 24 which, upon insertion of the plug 1 into the receptacle 2, engages the front rim 25 of the said rectangular opening 22. By employing a curved surface instead of a straight surface, the angle between the plane of the opening 22 and a tangent of the said surface 24 at the point of contact with the rim 25 can be controlled for each position of the pawl 23. Depending on the way the latch is mounted in the inner housing 5, this position can be expressed by way of an angle  $\alpha$  of downward or inward rotation, a distance L of downward or inward translation or a combination of the two.

[0020] The friction at the point of contact and, hence, the retention force with which the connector 1 is retained in its counterpart 2 is mainly determined by the coefficient of friction and the force exerted on the said point. If the tangent through the point of contact is comparatively steep, as would be the case in point 24A, the force exerted by the latch 11 on the rim 25 and, hence, the resulting friction will be relatively high. Conversely, a relatively flat tangent, as would be the case in point 24B, will result in a relatively low force and friction. Accordingly, the said force and friction can be controlled by selecting a suitable tangent, preferably for each point of the surface 24.

[0021] For instance, a minor and/or inadvertent downward shift in the position of the latch 11 will result in both a temporary lowering of the coefficient of friction (since the static coefficient of friction is temporarily replaced by a lower dynamic coefficient) at the said point of contact and a temporary increase of the force exerted by the resilient latch 11 which has a spring constant and has now been (slightly) impressed. These changes in turn can, especially in a straight surface, result in an unstable slip/stick effect and, ultimately, an unwanted release of the connector 1 from its counterpart 2. However, if the

tangent of the curved surface 24 at the point of contact with the rim 25 steepens with the said downward shift, as is the case in this example where the said point shifts from 24B to 24A, the reduction of the coefficient of friction is compensated by an additional increase (resulting from the steeper tangent) of the force exerted by the (slightly) impressed resilient latch 11 and inadvertent release of the connector is avoided.

[0022] If the latch 11 is rotatably mounted, a downward shift is coupled with a rotation of the latch 11 which in turn will cause the tangent and the friction at the point of contact to flatten respectively decrease. This phenomenon can also be compensated by selecting a suitable curved surface.

[0023] Figure 4 in conjunction with figures 5A, 5B, and 6 shows a second extension 26 of the latch 11 which reaches beyond a second rim 27 of the opening 22 opposite the first rim 25. This second extension 26 abuts the shielding 18 of the receptacle 2 upon rotation of the plug 1 about an axis both substantially perpendicular to the insertion direction (ID) of the plug 1 and parallel to the row of terminals 7, as might occur when someone trips over the cable 8. Thus, the first extension 23 is withdrawn from the opening 22 and the plug 1 is released before damage to e.g. the latches 11, 11', the pegs 10, 10' or the shielding 18 occurs.

[0024] If the first extension 23 and the second extension 26 build an angle, as shown in figures 5A and 5B, the latter extension 26 will not abut the shielding 18 during normal use and inaccuracies resulting from the manufacture of e.g. the element 12 will not initiate the said release prematurely.

[0025] To enable release of the plug 1 when a rotation in the opposite direction occurs, it is preferred that the pegs 10, 10' are rounded, at least at the side farthest removed from the latch 11. The rounded portion 28 is preferably shaped such as to allow the pegs 10, 10' to rotate out of the shielding 18 without breaking or causing the shielding 18 to deform plastically.

[0026] The invention is not restricted to the embodiments described above and can be varied in a number of ways within the scope of the claims. For instance, the connector according to the present invention may be a part of a mobile device, such as a mobile telephone, instead of a cable.

## Claims

- 50 1. Connector (1) comprising a housing (3,4), a plurality of electrical contacts (7), and at least one resilient latch (11) for establishing a mechanical connection with a connector counterpart (2) comprising an opening (22), such as a slot or notch, for receiving the latch (11), characterised in that the latch (11) comprises an extension (23) which, upon connection of the connector (1) to the counterpart (2), engages with a rim (25) or inner wall of the said open-

ing (22) and in that the surface (24) of the extension (23) that contacts the said rim (25) or inner wall is curved.

2. Connector (1) according to claim 1, wherein the said surface (24) is concave. 5
3. Connector (1) according to claim 1 or 2, wherein the connector (1) can be unlatched by pressing the latch (11) downwards, during which the tangent (24A, 24B) of the curved surface (24) at the point of contact with the rim (25) or inner wall steepens. 10
4. Connector (1) according to the preamble of claim 1, characterised in that the latch (11) comprises a first extension (23) which, upon connection of the connector (1) to the counterpart (2), engages with a first rim (25) or inner wall of the said opening (22) and a second extension (26) which reaches beyond a second rim (27) or inner wall of the opening (22) opposite the first rim (25) or inner wall and which abuts the counterpart (2) upon rotation of the connector (1) about an axis substantially perpendicular to the insertion direction (ID) of the connector (1). 15
5. Connector (1) according to claim 4, wherein the first extension (23) and the second extension (26) build an angle. 20
6. Connector (1) according in any one of the preceding claims, comprising at least one peg (10) for aligning the connector (1) with respect to its counterpart (2), wherein at least one side of the peg (10) is rounded. 25
7. Connector (1) according to claim 6, wherein the latch (11) is integrated with the peg (10) and at least the side of the peg (10) farthest removed from the latch (11) is rounded to such an extent as to allow removal of the connector (1) from its counterpart (2) by rotating the connector (1) about an axis substantially perpendicular to the insertion direction (ID) of the connector (1). 30
8. Connector (1) according to claim 6 or 7 comprising two mirrored pegs (10, 10'). 35
9. Cable (8) for connection to a mobile telephone comprising a connector (1) according to any one of the preceding claims. 40

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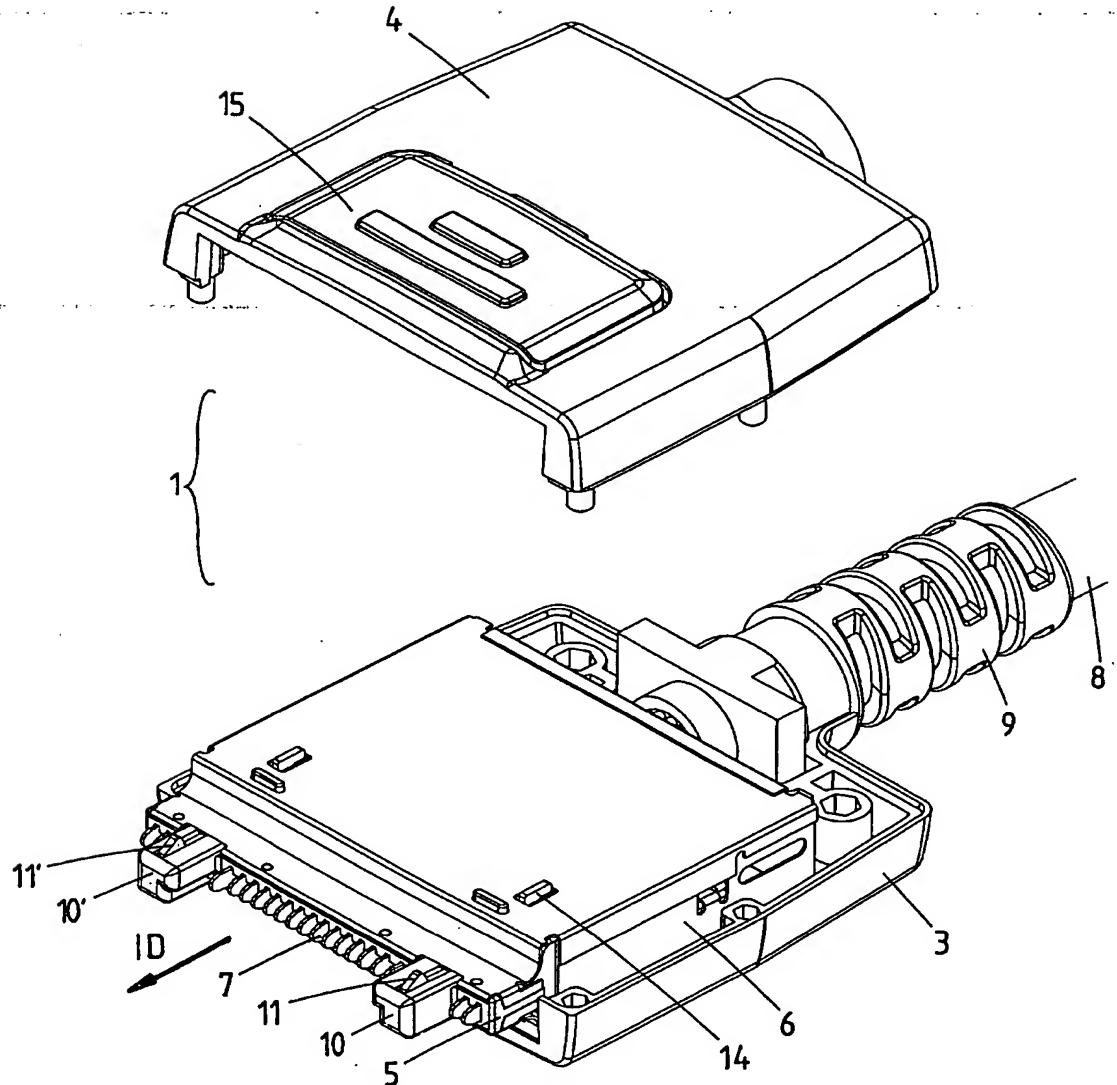


fig.1

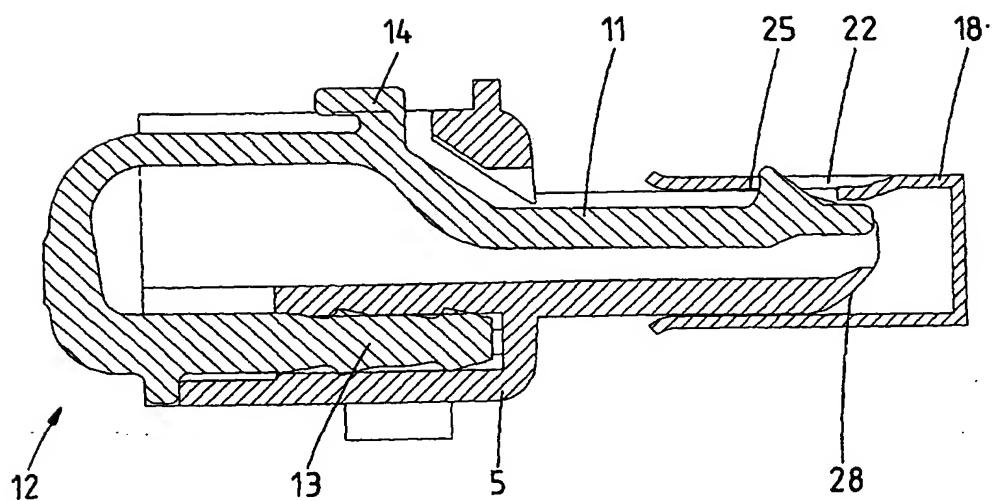


fig.2

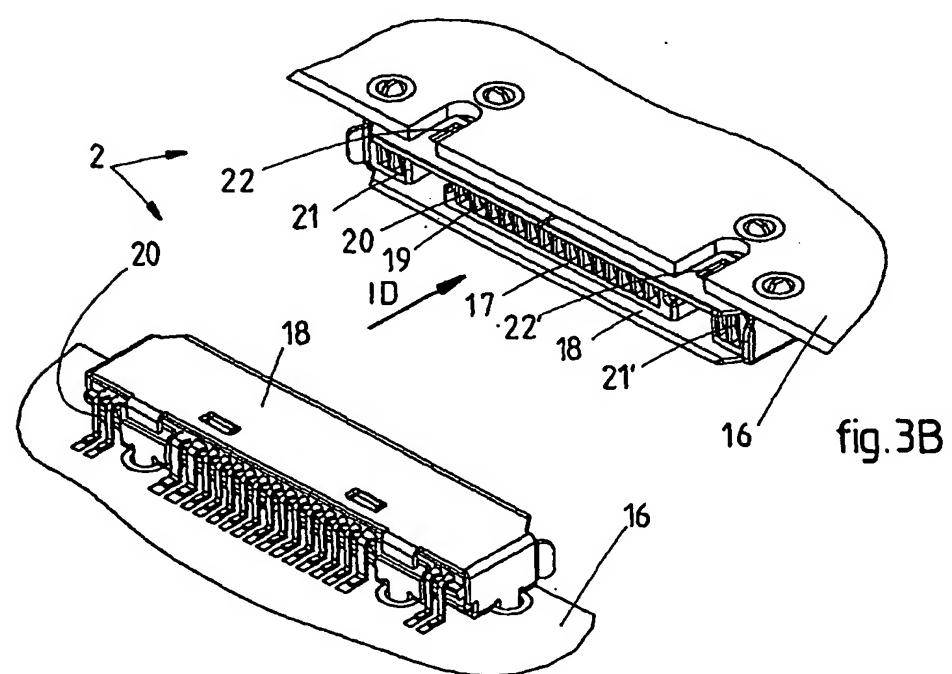


fig.3A

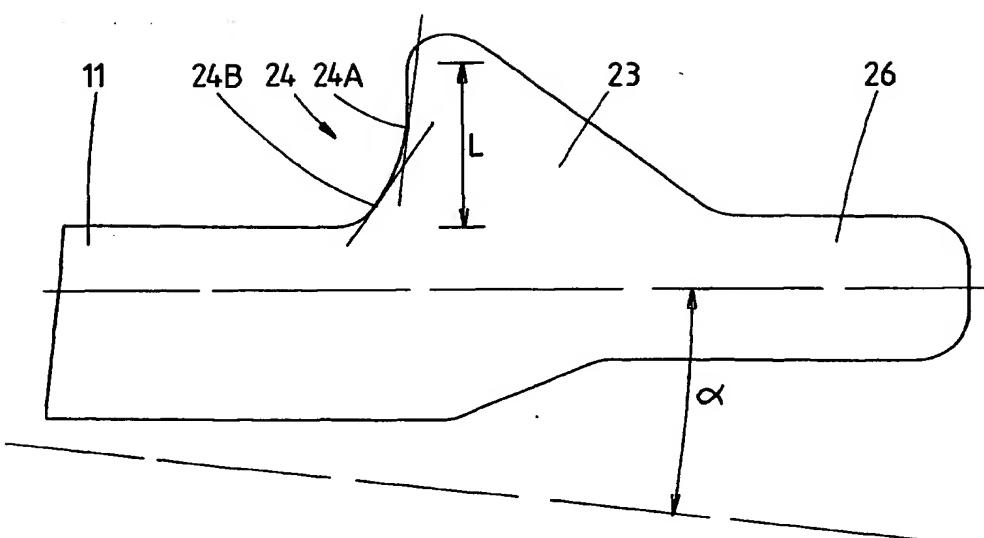


fig.4

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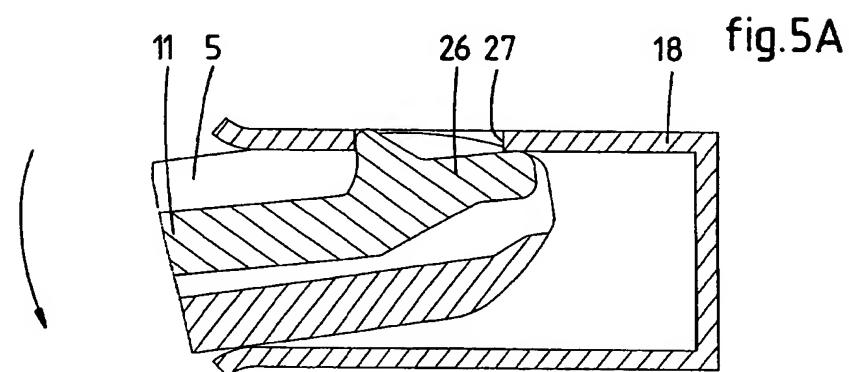
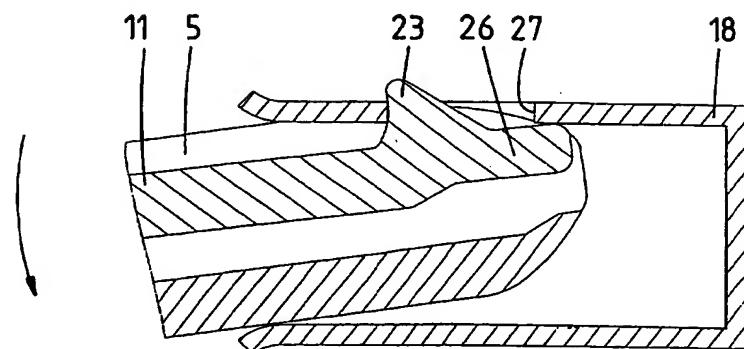


fig.5A

fig.5B

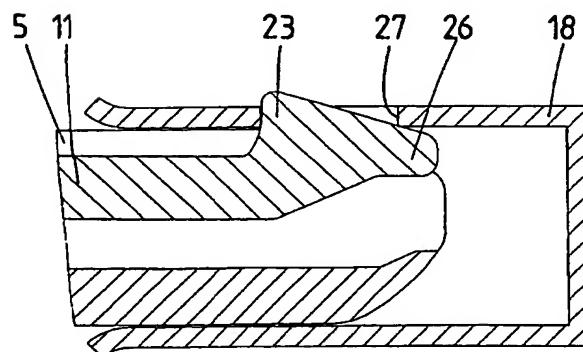


fig.6



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## EUROPEAN SEARCH REPORT

Application Number  
EP 01 20 5173

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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Y	US 4 548 455 A (EZURE TADAYOSHI) 22 October 1985 (1985-10-22) * column 2, line 31 - column 6, line 49 *	1	
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The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	2 April 2002	Demol, S	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 20 5173

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02-04-2002

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